MICROWAVE TREATMENT FOR DECARBONIZATION OF FLY ASH

James M. Tranquilla
prodmktg@emrmicrowave.com
tel. (506) 459-4334,
fax (506) 459-4345
EMR Microwave Technology Corporation
64 Alison Blvd.
Fredericton, New Brunswick, E3C 1N2

SUMMARY

The interaction between microwave energy and physical materials is determined by the properties of the material. Where industrial processes are concerned, the principal interaction is one which results in conversion of the microwave energy into heat which is then directly used to drive physical or chemical processes.

The principal mechanism for the conversion of microwave energy into heat in most mineral materials is ionic conduction, that is the electromagnetic field induces a form of electrical current in the material (or parts thereof) causing Ohmic loss resulting in heat generation. Since the penetration of the electromagnetic field into the material occurs at the speed of light and the induction occurs only in those constituents which are receptors, the heat generation is nearly instantaneous at the receptor although the thermal effects may not be observed throughout the entire material due to slow thermal conduction.

Organic carbon is an excellent microwave absorber even when present in relatively dilute concentrations. Carbonaceous minerals, for example, with 1-10% carbon content can be effectively decarbonized using a suitably designed microwave reactor. Obviously the carbon fuel value is below the level needed for autogenous operation and microwave energy provides the necessary reaction energy to burn the carbon to CO_2.

Fly ash containing residual organic carbon behaves similarly. By using a fluidized bed style reactor, the decarbonized ash can be produced without clinkering the silica and iron constituents.

In order to be valuable as a cement additive, fly ash carbon content must be less than 3%. An associated issue related to fly ash utilization is the adsorption of ammonia (ammonium sulphate) to the ash resulting from excess or unreacted ammonia used in flu gas NO_x scrubbing.

A microwave process has been used to treat several industrial fly ash samples with carbon content typically 14%-26%, reducing the carbon to as low as 0.2% as shown in the following Table.

	Sample #1	Sample #2	Sample #3
Mineralogy	Quartz Mullite($Al_6Si_2O_{13}$) Hematite	Gypsum Maghemite Hematite	Quartz Maghemite Hematite
LOI	26.1%	6.3% total *4.2% after gypsum	27.3%
Organic Carbon	25.2%	4.4%	N/D
LOI (microwave)	0.2%	2.4%	1.1%
Organic carbon (microwave)	N/D	2.4%	N/D

**after decomposition of gypsum to anhydrite*
N/D not determined

All samples were treated until they exhibited autocooling which signals the onset of carbon depletion.